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BRIEF REPORT

Experience Facilitates the Emergence of Sharing Behavior Among 7.5-Month-Old Infants

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Given the centrality of prosociality in everyday social functioning, understanding the factors and mechanisms underlying the origins of prosocial development is of critical importance. This experiment investigated whether experience with reciprocal object exchanges can drive the developmental onset of sharing behavior. Seven-month-old infants took part in 2 laboratory visits to assess their sharing behavior and ability to release objects. During the intervening 7- to 14-day period parents led infants in an intervention in which they were either encouraged to release objects into a container (bucket condition, $n = 20$), or share objects with the parent in the context of reciprocal object exchanges (sharing condition, $n = 20$). Results showed that infants in the sharing condition shared significantly more than infants in the bucket condition following the intervention, and infants in the sharing condition significantly increased their sharing behavior across the 2 visits. Parental empathy moderated the effect of this sharing intervention, but frequency of practice did not. These results suggest that reciprocal turn-taking in dyadic object-exchange interactions may facilitate the early emergence of sharing behavior, and this effect is mediated by parental empathy.

Keywords: sharing, experience, infancy, prosocial development

Prosocial behaviors, actions that benefit others, are ubiquitous and constitute the foundation for human cooperation and morality (Benson, 2011; Henrich et al., 2005). In particular, sharing behavior, defined as willingly giving resources to others, is an important form of prosociality in adults (Gurven, 2006) and children (Dunfield, Kuhlmeier, O'Connell, & Kelley, 2011). The roots of sharing behavior can be traced back to infancy. The most primitive form of sharing in naturalistic settings—infants offering objects to others without necessarily releasing them—emerges by 8 months of age, although such behaviors are infrequent (Bakeman, Adamson, Konner, & Barr, 1990). By 12 months of age, infants begin to share objects by offering and releasing them to others (Hay, 1979; Hay & Murray, 1982) and subsequently sharing behavior becomes more frequent and sophisticated by the end of the second year of life (Brownell, Svetlova, & Nichols, 2009; Rheingold, Hay, & West, 1976). Although research has established that there are rich developments in sharing behavior during infancy (Brownell, 2013), less work has examined factors that influence the developmental emergence of sharing behavior in the first place. Thus, in the current article our goal was to identify factors and experiences that drive the very emergence of sharing behavior.

Recent work suggests that reciprocal turn-taking object-exchanges elicit high degrees of altruism among 1- and 2-year-olds in laboratory helping tasks (Barragan & Dweck, 2014). Therefore, we hypothesized that regular practice of turn-taking object exchange could facilitate the onset of sharing. Such interactions likely support many elements crucial to the onset of sharing behavior, such as providing infants with experience understanding others' requests (Brownell et al., 2009; Gross et al., 2015), socializing infants into understanding the emotional consequences of sharing objects with others (Brownell, Svetlova, Anderson, Nichols, & Drummond, 2013) and introducing infants to the norm of reciprocal sharing (Barragan & Dweck, 2014)

A second goal of the current work was to identify individual difference variables that moderate the impact of this experience on infants' sharing; specifically, parental empathy and the amount of reciprocal object-exchange practice. Parental empathy, assessed through standard questionnaires like the Interpersonal Reactivity Index (IRI; Davis, 1983), is related to prosocial development broadly construed (Davidov & Grusec, 2006; Upshaw, Kaiser, & Sommerville, 2015; Volling, Kolak, & Kennedy, 2008), and infants' sharing behavior in the second year of life in particular (Cowell & Decety, 2015). Parental empathy might influence infants' sharing development by impacting the quality of parent–child sharing interactions, for example, by increasing parental responsiveness to infants' needs (see Dix, 1992; Feshbach, 1987; Stern, Borelli, & Smiley, 2015). Alternately or additionally, infants whose parents have high levels of empathy may themselves be

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more empathic and thus more likely to benefit from a sharing intervention. We also investigated whether the amount of infants' experience participating in reciprocal object-exchange interactions would impact infants' sharing behavior. Previous research has found, for example, that the sheer amount of experience in producing object-directed reaching actions predicts infants' recognition of the goal of other people's grasping action (Gerson & Woodward, 2014). Similarly, we thought that the amount of sharing practice might predict the impact of this experience on infants' sharing.

In the current study, we recruited 7-month-old infants to participate in an active intervention including two lab visits spaced 7 to 14 days apart with home practice between the two visits. Parents completed self-report empathy measures, Interpersonal Reactivity Index (IRI; Davis, 1983), and recorded frequency and amount of home practice. Infants in the sharing condition received training in giving objects to others, whereas infants in the bucket condition were trained on identical motor behaviors in matched dyadic interactions. Compared to the sharing training, the bucket training lacked the crucial element of reciprocal object-exchange; specifically, infants were taught to release an object into a bucket instead of the adult's hand, and the adult did not give the same object back to the infant. At their second visit, infants in both conditions were assessed in a sharing task. We hypothesized that only infants in the sharing condition would improve in sharing behavior, which would suggest that unique experience in reciprocal, turn-taking object exchange interactions matters for the emergence of sharing. We further hypothesized that infants whose parents had higher empathy score would share more after the sharing intervention, as would infants who practiced sharing more at home.

Method

Participants

Forty full-term, typically developing 7.5-month-old infants (24 girls; Visit 1 age: $M = 7$ months and 12 days, range = 7 months and 3 days to 7 months and 19 days; Visit 2 age: $M = 7$ months and 20 days, range = 7 months and 13 days to 7 months and 29 days) participated. Participants were recruited from a university-maintained database and identified by their parents as White ($n = 34$), mixed race ($n = 4$), and Asian ($n = 2$). An additional infant was tested and excluded due to nonengagement in the task.

Infants participated in either the sharing condition ($n = 20$, 11 girls, Visit 1 age: $M = 7$ months and 13 days, Visit 2 age: $M = 7$ months and 21 days) or the bucket condition ($n = 20$, 13 girls, Visit 1 age: $M = 7$ months and 11 days, V2 age: $M = 7$ months and 19 days).

Procedures

Participants made two visits to our lab, between 7 and 14 days apart (sharing condition: $M = 9.30$, bucket condition: $M = 8.00$). At Visit 1 (V1), infants in the sharing/bucket condition participated in the sharing/bucket game followed by the sharing/bucket tutorial. The bucket game was designed as a control game to match the sharing game in structure, with the following differences: Infants in the sharing condition were taught to release the toy into Experimenter 1's (E1's) hand, while infants in the bucket condition were taught to release the toy into a specially constructed "bucket" (see Figure 1); infants in the sharing game experienced reciprocal changes of the same toys while infants in the bucket game did not. The sharing/bucket game included a 90-s warm-up phase for the infant to get familiar with the setting and a 6-min test phase that alternated between Infant Trials, in which infants interacted with E1 and were encouraged to either share toys with the E1 or drop toys into her bucket, and Experimenter Trials, when infants watched toy sharing or toy releasing interactions between the two experimenters (see Figure 2). After the sharing/bucket game, parents received a sharing/bucket tutorial (see Figure 3) in which they practiced the sharing/bucket game with infants under experimenters' instructions. Parents and infants then practiced each respective game at home. At Visit 2 (V2), infants in both conditions participated in the same sharing game. Parents completed the IRI prior to the procedures at V1 and brought back home-practice logs at V2. Experimenters called the parents two times between the visits in order to give guidance, answer questions, and ensure that parents were complying with practice instructions. More details about the procedures of the two conditions can be found in Appendix A.

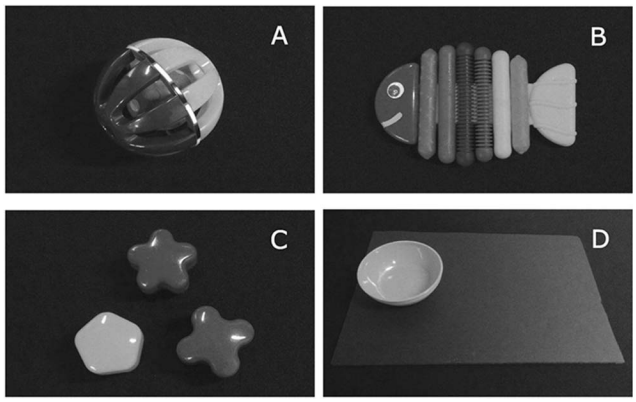

Figure 1. Materials. Panel A: A ball (warm-up phase), 9 cm diameter. Panel B: A fish (sharing/bucket game), 11.5 cm × 7.5 cm. Panel C: A red shaker, a yellow shaker (sharing/bucket game), and a green shaker (bucket game), 4.5 cm diameter, 3.5 cm height. Panel D: The specially constructed "bucket" (bucket game), a bowl (11.75 cm diameter, 3.75 cm depth) glued onto the end of a black foam-board (38.5 × 25.5 cm).

Coding

Sharing behavior. The main dependent variable was the number of shares infants produced upon E1's request during the 6-min session (V2 for both conditions and V1 for the sharing condition). A "share" was defined as the infant intentionally releasing the toy into E1's hand in response to E1's request. A detailed description of the coding scheme is presented in Appendix B.

Dropping behavior (V2). One could argue that by teaching infants to release a toy into a container, the bucket game might encourage infants to drop toys, such that infants might be deprived of the opportunity to share in a given request window. To rule out the possibility that differences in sharing across the two conditions were due to infants in the bucket condition being preoccupied with

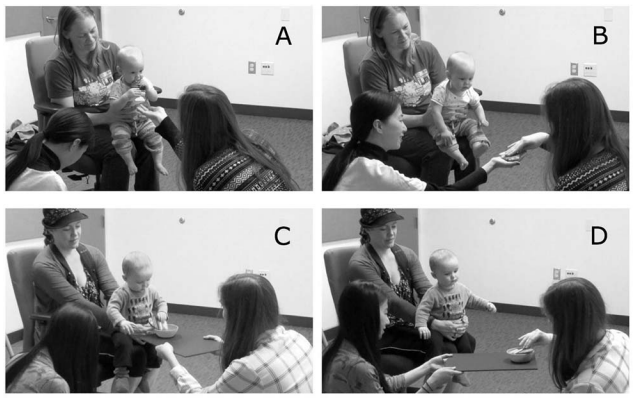

Figure 2. The sharing/bucket game. Panel A: Infant trial (sharing game). Panel B: Experimenter trial (sharing game). Panel C: Infant trial (bucket game). Panel D: Experimenter Trial (bucket game). The individuals whose faces appear here gave signed consent for their likeness to be published in this article.

dropping objects, we coded the number of drops infants produced upon E1's request at V2. A "drop" was defined as infant releasing the toy in the request-response opportunity window and failing to meet the criteria of a share (see Appendix B). We also coded the number of E1's requests to make sure that neither condition was given more opportunities to share than the other.

Releasing behavior (V1). In order to ensure that the bucket game was at least as effective as the sharing game in training critical object-release motor skills, we also coded releasing behavior at V1 in the bucket condition. A "bucket-release" was defined as infant intentionally releasing the toy into the bucket in response to E1's request (see Appendix B).

All participants were scored by a primary coder. A second coder, blind to the study hypotheses, coded half of participants. Intercoder agreement was very good for the shares/drops and releases/drops. For the sharing condition, Cohen's kappa was 1 for V1 (shares/drops) to .897 for V2 (shares/drops); for the bucket condition, Cohen's kappa was .717 for V1 (releases/drops) to .867 for V2 (shares/drops). In cases of disagreement, a third coder assigned the code.

Parental measures. Primary caregivers completed the IRI and the home-practice log. The IRI is composed of four subscales (seven items for each subscale) that assess dispositional empathy. The perspective-taking subscale measures the tendency to adopt others' point of view (e.g., "I try to look at everybody's side of a disagreement before I make a decision"); the fantasy subscale

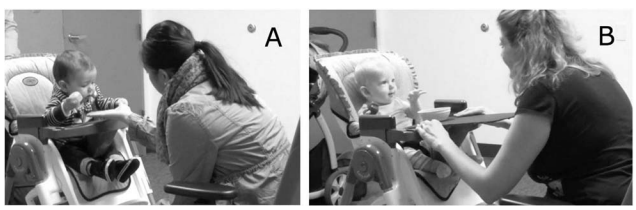

Figure 3. Parent tutorial. Panel A: Sharing game tutorial. Panel B: Bucket game tutorial. The individuals whose faces appear here gave signed consent for their likeness to be published in this article.

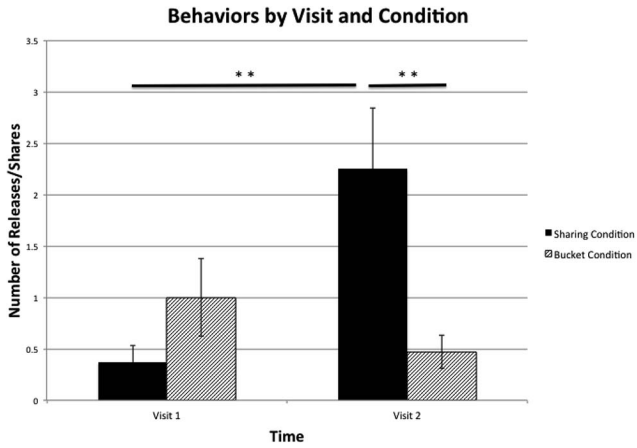

Figure 4. Number of shares and releases across condition and visit (all four columns are number of shares except Bucket Condition at Visit 1 [V1], because infants in the bucket condition participated in the bucket game instead of the sharing game at V1). Error bars represent standard errors. ** $p < .01$.

measures absorption in fictional characters (e.g., "I really get involved with the feelings of the characters in a novel"); the empathic concern subscale measures other-oriented responses to others' suffering (e.g., "I often have tender, concerned feelings for people less fortunate than me"); the personal distress subscale measures self-focused responses to others' suffering (e.g., "Being in a tense emotional situation scares me"). The empathic concern subscale arguably measures the most prototypical conception of empathy and predicts prosocial tendencies (Konrath, O'Brien, & Hsing, 2010), whereas personal distress is negatively associated with pro-social behavior such as social support (Devoldre, Davis, Verhofstadt, & Buysse, 2010). Perspective-taking scores predict prosocial behaviors such as volunteerism (Oswald, 2003), but the fantasy subscale is not related to prosocial tendencies (Unger & Thumuluri, 1997).

The practice log was a structured table where parents recorded the following for each practice session: date, start and end time, who played the game with the infant, and whether the infant successfully shared (sharing condition) or released (bucket condi-

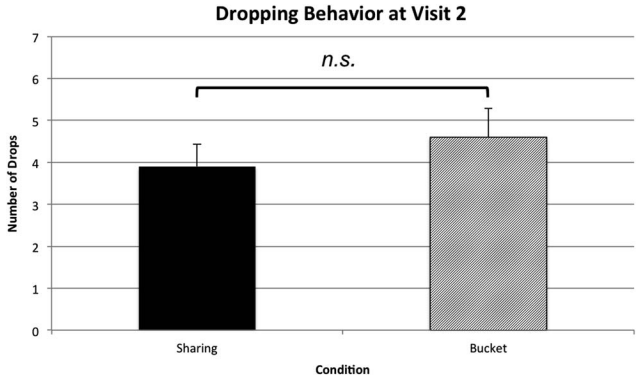

Figure 5. *n.s.* = non-significant. Number of drops in the sharing condition and bucket condition at Visit 2. Error bars represent standard errors.

Table 1
Parental Support and Success Rates for the Sharing and Bucket Condition

Variable category	Variable	Sharing condition, *M* (*SE*)	Bucket condition, *M* (*SE*)	*t* (*df*)	*p*
In-lab parent session	Number of verbal requests	4.67 (0.53)	6.00 (0.67)	−1.55 (35)	.129
	Number of physical cues	0.72 (0.27)	4.48 (0.63)	−5.40 (35)	<.001***
	Available time	17.95 (2.23)	28.99 (3.12)	−2.85 (35)	.007**
Home practice	Number of successful sessions	3.70 (0.82)	3.35 (0.70)	0.32 (38)	.748
	Proportion successful sessions	32.40% (0.05)	42.49% (.08)	−1.03 (38)	.310

Note. Parents in the first minute of the bucket-game tutorial at Visit 1 (bucket condition) had significantly more physical cues ($p < .001$) and longer available time ($p < .01$) than parents in the sharing condition. These results argue against the alternative explanation that infants in the sharing condition shared more than those in the bucket condition because of higher parental support/cues in the sharing game than in the bucket game.
** $p < .01$. *** $p < .001$.

tion) a toy. We computed total practice time to represent practice quantity. We also computed the number of sessions the infant was reported to successfully share (sharing condition) or release (bucket condition) a toy, the proportion of sessions that were successful, and the proportion of sessions that involved only one person other than the infant (a dyadic interaction).

Additional measures. In order to ensure that infants in the one condition were not more engaged than infants in the other, infants' visual attention during Infant and Experimenter Trials was coded. To ensure that infants in the two conditions received equivalent positive reinforcement and reacted equivalently, E1's positivity and infant's emotional reaction to E1's praise at the end of each toy transfer were coded, using a 1-to 5-point scale (see Appendix C). To ensure that parents provided equivalent support and scaffolding to infants in both conditions, parents' verbal cues, physical cues, and available time when the hand or bucket was extended were coded for the first minute of the tutorial session (not every infant finished the entire 2-min session; see Appendix B). Two coders independently coded these measures and intercoder agreements were high. Visual attention in Infant Trials: $r(14) = .96$, $p < .0001$; visual attention in Experimenter Trials: $r(14) = .95$, $p < .0001$; E1 positivity score: $r(14) = .83$, $p < .0001$; infant emotional reaction score: $r(14) = .98$, $p < .0001$; available time in parent-tutorial session: $r(17) = .99$, $p < .00001$; verbal cues in parent-tutorial session: $r(17) = .95$, $p < .0001$; physical cues in parent-tutorial session: $r(17) = .98$, $p < .0001$.

Results

Infants Learn to Share in the Sharing Condition

We performed a 2x2 ANOVA with condition as the between-subjects factor and visit as the within-subjects factor in order to investigate the impact of condition and visit on infants' sharing behavior. We found a significant main effect of visit: $F(1, 36) = 5.261$, $p = .028$, partial $\eta 2 = .128$, and a marginally significant main effect of condition: $F(1, 36) = 3.141$, $p = .085$, partial $\eta 2 = .080$, qualified by a significant interaction between condition and visit number: $F(1, 36) = 9.365$, $p = .004$, partial $\eta 2 = .206$. At V1 infants in the sharing condition were no more likely to share objects than infants were to release objects in the bucket condition, revealed by an independent samples *t* test between V1 sharing behavior in the sharing condition ($M = .37$, $SE = .16$) and V1 releasing behavior in the bucket condition ($M = 1.00$, $SE = .38$), $t(37) = 1.49$, $p = .144$. In contrast, an independent samples *t* test yielded a significant difference between the sharing condition ($M = 2.25$, $SE = .59$) and the bucket condition at V2 ($M = .47$, $SE = .16$), $t(21.78)$[1] $= 2.85$, $p = .008$, 95% confidence interval (CI) [.510, 3.042], Cohen's $d = .91$[2] (see Figure 4). These findings suggest that at V2 infants in the sharing condition shared significantly more frequently than infants in the bucket condition.

We next tested improvements across the two visits. A paired-samples *t* test revealed a significant increase from V1 ($M = .37$, $SE = .16$) to V2 ($M = 2.32$, $SE = .62$), $t(18) = 3.055$, $p = .007$, 95% CI [.608, 3.055], Cohen's $d = .86$ for infants in the sharing condition.[3] By comparison, in the bucket condition a paired samples *t* test indicated no significant difference from releases at V1 ($M = .79$, $SE = .39$) to shares at V2 ($M = .47$, $SE = .16$), $t(18) = .84$, $p = .411$ (see Figure 4). This suggests that the sharing intervention, but not the bucket intervention, resulted in improvements in sharing behavior.

Finally, we compared sharing rates in the bucket condition at V2 to those in the sharing condition at V1. An independent samples *t* test revealed that the bucket condition's sharing performance at V2 ($M = .47$, $SE = .16$) was similar to that of the sharing condition at V1 ($M = .37$, $SE = .16$): $t(36) = .47$, $p = .641$ (see Figure 4). These results indicate that infants in the bucket condition at V2 showed no differences in sharing frequency from baseline rates in the sharing condition at V1.

Ruling out Alternative Hypotheses

Does dropping behavior supplant sharing behavior? One alternative explanation is that infants shared more in the sharing condition because the bucket game, by teaching infants to release a toy into a container, might encourage infants to simply drop toys and thus supplant sharing behaviors. An independent samples *t* test

[1] In some measures our reported degrees of freedom in the *t* statistics were noninteger values, because variances were not homogeneous for these values.

[2] We performed an outlier analysis to all the variables analyzed in this section, using the criterion of 3 standard deviations from the mean as the upper/lower bounds. We excluded one outlier for number of shares at V1 from the sharing condition, and another outlier for number of shares at V2 from the bucket condition. The difference in V2 sharing behavior between sharing and bucket conditions remains significant, even if the outlier is included ($p = .042$).

[3] The difference between V1 and V2 shares in the sharing condition remains significant, even if the outlier is included ($p = .018$).

Table 2
Means of Ancillary Variables for the Sharing and Bucket Condition

Variable category	Variable	Sharing condition, *M* (*SE*)	Bucket condition, *M* (*SE*)	*t* (*df*)	*p*
Opportunities to share	Number of requests	17.55 (0.96)	18.45 (0.91)	−0.68 (38)	.499
Infants' visual attention in the sharing game	Infant trials	74% (0.035)	82% (0.022)	−1.50 (31.98)	.142
	Experimenter trials	86% (0.017)	85% (0.016)	0.25 (38)	.803
Positive reinforcement	E1 positivity	4.01 (0.06)	4.12 (0.08)	−0.96 (38)	.344
	Infant emotional reaction	2.53 (0.13)	2.59 (0.13)	−0.32 (38)	.752
Home practice	Total time (minutes)	52.90 (4.07)	56.55 (5.80)	−0.44 (38)	.610
	Proportion of dyadic sessions	87.83% (0.05)	86.85% (0.04)	0.16 (37)	.874
Parental empathy	Perspective taking	18.95 (0.77)	20.30 (0.82)	−1.20 (38)	.238
	Empathic concern	19.15 (0.56)	22.40 (0.68)	−3.67 (38)	.001**
	Personal distress	8.65 (1.06)	9.20 (1.17)	−0.35 (38)	.730
	Fantasy	16.15 (1.00)	17.65 (0.89)	−1.12 (38)	.269

Note. None of the comparisons yielded statistically significant ($p < .05$) results except one variable: parents' empathic concern scores were significantly higher in the bucket condition than in the sharing condition ($p = .001$), which argues against the explanation that infants in the sharing condition shared more than those in the bucket condition due to their parents having higher dispositional empathy. E1 = Experimenter 1.
** $p < .01$.

revealed no significant difference in dropping behavior at V2 between the sharing condition ($M = 3.90$, $SE = .54$) and the bucket condition ($M = 4.50$, $SE = .54$) at V2, $t(30) = .70$, $p = .486$ (see Figure 5). This indicates that infants' differential sharing performance cannot be explained by increased dropping behavior.

Is the bucket game less effective in training object release behavior? One could argue that the bucket game was not as effective as the sharing game in training object-release behavior, because infants were taught to release objects less directly in the bucket game (releasing into a bucket) than the sharing game (releasing into E1's hand).

We first compared infants' sharing/releasing behavior in the sharing/bucket condition at V1. An independent samples *t* test revealed no significant difference between sharing behavior in the sharing condition ($M = .37$, $SE = .16$) and releasing behavior in the bucket condition ($M = 1.00$, $SE = .38$) at V1, $t(37) = 1.49$, $p = .144$. This result suggests that infants' release rates in the initial bucket game were similar to infants' sharing rates in the initial sharing game.

We then examined parents' support in the sharing/bucket game tutorial at V1, by analyzing parents' verbal cues, physical cues, and total time when the hand or bucket was extended (in seconds). We found that parents' supportive cues in the bucket-game tutorial were either equivalent to those in the sharing game (verbal cues), or greater (physical cues and total available time; see Table 1). This suggests that parents were at least as supportive in the bucket game as in the sharing game.

We also computed the number of sessions parents reported "Yes" to the question of whether baby intentionally shared a toy (sharing condition) or released a toy into the bucket (bucket condition), as well as the proportion of "Yes" sessions to total sessions for every infant. We found that infants in the bucket condition had at least equivalent rates of intentional releasing behavior compared to intentional sharing behavior by infants in the sharing condition, according to parental report (see Table 1). This indicates that parents were no less effective in the bucket game than in the sharing game. Taken together, these results suggest that the bucket game was as effective in training infants' object-release as the sharing game.

Are there group-level differences in ancillary variables that could explain differences between conditions? We also examined whether the differential sharing performance across the two conditions was driven by group-level differences in ancillary factors, such as number of requests, E1 positivity, infants' visual attention and emotional reaction in the sharing game at V2, home-practice amount, dyadic sessions, and parental empathy (see Table 2). There were no systematic differences that could explain the key findings.

Moderators of Individual Differences in Intervention Effectiveness

To explore whether home-practice predicted improvement in sharing behavior, we correlated the number of home-practice ses-

Table 3
Pearson's Correlations Between Home-Practice and Sharing Behavior at V2 In The Sharing Condition

Variable	1	2	3
1. V2 shares	—		
2. Total time	.290	—	
3. Number of sessions	.289	.255	—

Note. None of these correlations were significant (all $ps > .05$). $N = 20$ for all analyses. V2 = Visit 2.

Table 4
Pearson's Correlations Between Home-Practice and Sharing Increase From V1 To V2 In The Sharing Condition

Variable	1	2	3
1. V1 to V2 sharing increase	—		
2. Total time	.331	—	
3. Number of sessions	.312	.255	—

Note. None of these correlations were significant (all $ps > .05$). $N = 19$ for all analyses, except that for the correlation between total time and number of sessions, $N = 20$. V1 = Visit 1; V2 = Visit 2.

sions and total practice time with the number of shares at V2 and increase in sharing behavior from V1 to V2 for the sharing condition. No significant relations were found (see Table 3 and 4), suggesting that amount of home practice was unrelated to infant sharing behavior.

We also investigated whether parental empathy (as assessed via the IRI) predicted the effect of sharing intervention. For infants in the sharing condition, we found that parents' empathic concern scores were positively correlated with number of shares at V2, $r(18) = .51$, $p = .022$, and also positively correlated with sharing increase from V1 to V2, $r(17) = .50$, $p = .028$, suggesting that infants whose parents were more empathically concerned for others benefited more from the sharing intervention. Personal distress scores were negatively correlated with the number of shares at V2, $r(18) = -.457$, $p = .043$, and also negatively correlated with sharing increase from V1 to V2, $r(17) = -.473$, $p = .041$ (see Table 5), suggesting that infants whose parents were less personally distressed by others' situations benefited more from the sharing intervention. Critically, empathic concern and personal distress still significantly predicted sharing performance at V2 and sharing increase from V1 to V2, even after controlling for home-practice amount in follow-up partial correlations.[4]

In contrast, for infants in the bucket condition, we found that number of shares at V2 was not correlated with parental empathic concern, $r(17) = -.20$, $p = .416$, or personal distress, $r(17) = -.36$, $p = .133$ (see Table 6), suggesting that parental empathy didn't predict sharing behavior in the bucket condition. In addition, to address the concern of whether parental empathy broadly impacted the releasing interaction (rather than the sharing interaction per se), we analyzed the relationships between parental empathy and infants' releases (bucket condition) or shares (sharing condition) at V1, and we didn't find any significant correlations (see Table 5 and 6). Taken together, these results indicate that parental empathy predicted the effects of the intervention in the sharing condition only.

Discussion

Our study demonstrated the effect of reciprocal object-exchange experience in the emergence of sharing behavior. While infants in the sharing condition rarely shared at V1, their sharing rates increased sixfold following the sharing intervention, indicating that our intervention had a large effect on infants' sharing behavior. Also, infants in the sharing condition shared significantly more than those in the bucket condition at V2, suggesting that sharing behavior uniquely improved for infants in the sharing condition. Our study demonstrates the efficacy of a sharing intervention with reciprocal object exchange in driving the developmental onset of sharing behavior.

Our data allowed us to rule out alternative interpretations for differences across the two conditions at V2, such as that dropping behavior supplanted sharing behavior, or that the bucket game was not as effective as the sharing game in training object release. The two conditions were equivalent in other variables that might account for different rates of sharing, such as opportunities for sharing, infants' interest and emotional reaction in the task, E1's positivity, home-practice amount, and parental empathy. The only difference between the conditions was that infants in the sharing condition had reciprocal, turn-taking object exchange experience while infants in the bucket condition did not. These findings suggest that reciprocal, turn-taking exchange is the crucial experience that led to the emergence of sharing behavior among these young infants.

What did infants gain from the reciprocal, turn-taking object exchange experience that led to the increase in sharing behavior? Infants might have gained the social–cognitive skills to understand the communicative cues of the experimenter's request, skills that have been shown to affect sharing in older infants (Brownell et al., 2009). Additionally, infants might have become aware of sharing's emotional consequences for others, which in turn would increase infants' motivation to share. However, since the bucket game had a similar amount of communicative cues as the sharing game, and, since infants across both conditions reacted equally positively at V2, these are unlikely the sole reasons for improved sharing behavior. Instead, we speculate that infants might have construed a norm of reciprocal sharing from the reciprocal object-exchange experience, in line with previous research (Barragan & Dweck, 2014), and thus learned to share objects in response according to this norm.

Table 5
Pearson's Correlations Between Parental Empathy (IRI Scores) and Infants' Sharing Behavior in the Sharing Condition

Variable	1	2	3	4	5	6	7
1. V2 shares	—						
2. V1 to V2 sharing increase	.969**	—					
3. V1 shares	−.006	−.252	—				
4. Perspective taking	.048	.039	.096	—			
5. Fantasy	−.236	−.192	−.084	.355	—		
6. Empathic concern	.510*	.502*	.084	.635**	.335	—	
7. Personal distress	−.457*	−.473*	.042	.394	.418	.084	—

Note. $N = 19$ for analyses involving V1 shares and V1 to V2 sharing increase, as one outlier was excluded. $N = 20$ for all other analyses. IRI = Interpersonal Reactivity Index; V1 = Visit 1; V2 = Visit 2.
* $p < .05$. ** $p < .01$.

Table 6
Pearson's Correlations Between Parental Empathy (IRI Scores) and infants' Releasing/sharing Behavior in the Bucket Condition

Variable	1	2	3	4	5	6
1. V2 shares	—					
2. V1 releases	−.006	—				
3. Perspective taking	.375	−.158	—			
4. Fantasy	−.257	−.316	.065	—		
5. Empathic concern	−.198	.000	.349	.502*	—	
6. Personal distress	−.357	.023	−.611**	.206	−.233	—

Note. $N = 19$ for analyses involving V2 shares and $N = 20$ for all other analyses. IRI = Interpersonal Reactivity Index; V2 = Visit 2; V1 = Visit 1.
* $p < .05$. ** $p < .01$.

[4] After controlling for total practice time, the following correlations remain significant: empathic concern and number of shares at V2, $r(14) = .53$, $p = .024$; empathic concern and sharing increase from V1 to V2, $r(14) = .49$, $p = .038$; personal distress and number of shares at V2, $r(14) = -.477$, $p = .045$; personal distress and sharing increase from V1 to V2, $r(14) = -.474$, $p = .047$.

One might wonder which part of the sharing game—observation or active practice—played a more important role in facilitating infants' sharing development. Although our findings cannot directly answer this question, we speculate that active participation is more important. First, prior work suggests that active experience plays an important role and may have a distinct effect over observational experience in infants' understanding of others' actions (Henderson, Wang, Matz, & Woodward, 2013; Gerson & Woodward, 2014; Gerson, Bekkering, & Hunnius, 2015; Sommerville, Hildebrand, & Crane, 2008). By extension, we think active experience was more important in facilitating sharing. Second, we didn't instruct parents to model the sharing game to infants, and self-report measures showed that most parents didn't include modeling in home-practice (see rates of dyadic practice in Table 2). Our check-in phone calls also corroborated this possibility.

We also investigated which individual difference factors influenced the effectiveness of the sharing intervention. For infants experiencing the sharing intervention, those whose parents had higher empathic concern and/or lower personal distress shared more at V2 and improved more across the two visits. While empathic concern measures other-oriented feelings, personal distress measures self-oriented feelings, which are an obstacle against behaving empathically. Therefore, our results suggest that infants whose parents have higher empathy benefit more from the sharing intervention. Higher-empathy parents might be more attuned to infants' needs and more responsive during the sharing practice, which might lead to higher quality of sharing interactions. Alternatively or additionally, infants of higher-empathy parents might themselves be more empathic and thus share more after the training. Future work can tease apart these two possibilities and further examine the link between parental empathy and infants' prosocial development at its earliest stage.

Intriguingly, we found that amount of home-practice didn't predict infants' sharing improvements. This finding may be in line with recent research on how the quality rather than quantity of parent–child interactions matters for early prosocial development (Brownell et al., 2013) and later success (Milkie, Nomaguchi, & Denny, 2015). Future research can further investigate how practice quality and quantity relate to the development of sharing and other types of pro-social behavior.

One outstanding question is to what extent this intervention would generalize to sharing improvement in other contexts. It is important to point out that infants' success in the in-lab task did require some generalization from their practice at home. The lab assessment involved a structured task with an experimenter in a lab setting, while home-practice consisted of informal experiences with the parent in a home setting. Future work can assess whether infants who practice the sharing game at this young age show increased sharing behavior when they get older, whether the sharing intervention leads to better performance in other kinds of sharing tasks, and whether the sharing intervention leads to enhancement in other prosocial behaviors and/or other dimensions of social cognition. Examining whether the sharing intervention generalizes to other types of pro-social behavior will help us to understand other important issues in prosocial development, such as whether pro-social behavior is a unified construct (Dunfield, 2014).

To conclude, the present study demonstrated the efficacy of a sharing intervention in facilitating the emergence of sharing behavior among 7.5-month-old infants, and further showed that parental empathy predicted the degree to which this intervention was effective. Our findings suggest that specific reciprocal turn-taking experiences that might introduce infants to the norm of sharing may be an important driving force in sharing development, and that parental empathy mediates the effects of these experiences. Our study provides the first step to fully understanding the mechanisms that lead to the very emergence of sharing.

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Appendix A

Procedures for the Sharing and Bucket Condition

Sharing Condition V1: Sharing Game

Materials

A ball (9 cm diameter) was used in the warm-up phase and four toys were used in the test phase: 2 rainbow fish (11.5 cm × 7.5 cm), a red shaker, and a yellow shaker (4.5 cm diameter, 3.5 cm height; see Figure 1.A–C).

Setting

A blanket (107 × 109 cm) was placed on the floor to designate the spots for the infant/parent and experimenters to sit. The parent sat in a rolling chair on the blanket, and the infant sat in the parent's lap. Experimenter 1 (E1) and Experimenter 2 (E2) sat on the floor at two corners of the blanket, E1 approximately 95 cm away from the parent and facing the infant, and E2 approximately 70 cm away from the parent. The seating arrangement was designed to make sure E1 could readily engage in eye contact with the infant. The toys were in a container behind E1.

Warm-Up Phase

This phase lasted for 90 seconds (all timing done by E2) in which E1 greeted the infant and gave him or her a ball to play with.

Test Phase

This phase alternated between two types of trials, Infant Trials and Experimenter Trials, and lasted for 6 minutes. In Infant Trials (see Figure 2.A), E1 handed the infant a fish toy. After a few

(*Appendices continue*)

seconds, E1 extended her hand, cupped with palm up, and requested the toy (e.g. "Hey [infant's name], can I have your toy?"). If the infant gave her the toy, E1 praised the infant with positive language and affect (e.g. "Thank you for the toy! Great job!"). If the infant did not give her the toy, E1 repeated the request every 5 seconds. Each request used different hand gestures to get the infant's attention, following this pattern: initial hand extension, wiggling the fingers, pointing at the toy, shaking the whole hand. If after these four requests the infant still had not given E1 the toy, she gently took the toy from the infant, followed with praise and positivity, as if the infant had done it on his or her own. E1 then returned the toy to the infant and repeated the interaction until she had the toy back a second time. Two transfers of toys from infant to experimenter marked the ending of this Infant Trial.

In the Experimenter Trials (see Figure 2.B), E1 and E2 requested and gave the toy to each other. This interaction served two purposes: giving the infant a demonstration of sharing, and preventing the infant from getting bored by giving him or her a short break from the infant-experimenter interaction. E2 requested the toy with her hand out, palm up (e.g. "Hi [experimenter's name], can I have a turn?"). E1 responded in an affirmative tone (e.g. "Sure, here you go.") and slowly placed the toy into E2's hand. E2 thanked E1.They repeated the interaction with reversed roles and then went back and forth one additional time. E1 turned back to the infant to start another Infant Trial.

Sharing Condition V1: Sharing Tutorial

In this session (see Figure 3.A), parents practiced the sharing game under experimenters' guidance, and were also given written instructions for home-practice.

The same toy set in the sharing game was used in this tutorial. The tutorial took up to two minutes. The infant sat in a high chair and the parent sat in the rolling chair, facing the infant. E1 and E2 stood behind and away from the high chair. The parent was instructed to hand the infant a toy and then repeat the same style of requests they observed the experimenters using. If the infant didn't release the toy after a few requests, the parent was instructed to gently take the toy from the infant and praise the infant.

E1 also gave parents the At-Home Practice Package, which included written instructions and the home-practice log. Parents were asked to practice the sharing game with their infants at home for ten minutes each day and fill out the practice log.

Bucket Condition V1: Bucket Game

The bucket game was designed as a control game to match the sharing game in structure. In the bucket game, infants were taught to release the toy into a hand-sized bowl instead of E1's hand. To control for the possibility that infants in the bucket condition might construe putting the toy in the bowl as sharing with the experimenter, we used a foam board to create distance between the bowl and E1, attaching the bowl to the far end of the foam board.

Materials

A ball was used in the warm-up phase and six toys were used in the test phase: 3 rainbow fish, and 3 shakers (red, yellow and green). A specially constructed bucket was used, with a bowl (11.75 cm diameter, 3.75 cm depth) glued onto the end of a black foam-board (38.5 $\times$ 25.5 cm; see Figure 1.A-D).

Setting

The setting was the same as the sharing game, except that an additional container was placed next to E1 to be used in the Infant Trials, and two additional toys (rainbow fish and green shaker) were placed behind E2 to be used in the Experimenter Trials.

Warm-Up Phase

The procedure was the same as the sharing game.

Test Phase

The procedure was structurally similar to the sharing game, with the following exceptions:

In Infant Trials (see Figure 2.C): A) Instead of extending her hand to the infant, E1 extended the bucket while holding the foam board and instructed the infant to release the toy into the bowl (e.g. "Hey [infant's name], can you put the toy in the bucket?"). B) When the toy was released into the bucket, E1 praised the infant with positive language and affect (e.g. "That's right! Great job!"), but avoided saying "Thank you," as "Thank you" might lead infant to interpret this interaction as sharing. C) Once the toy was in the bucket E1 retracted the bucket and put the toy into the plastic container next to her.

In Experimenter Trials (see Figure 2.D), E1 and E2 requested and released the toy into the bucket. A) Instead of transferring one toy, the experimenters transferred four toys. Each experimenter had two toys to start with and they both requested and released twice. B) The request was to put the toy in the bucket, and the affirmative language and praise included "Sure, I'll put it right here," and "Wow, that's right," instead of "Sure, here you go." or "Thank you." C) Every toy went from one experimenter to the other's bucket, and the other experimenter took it out and put it

(*Appendices continue*)

aside. Thus the same toy wasn't exchanged back and forth and the toys didn't end in the experimenters' hands.

Bucket Condition V1: Bucket-Game Tutorial

The bucket-game tutorial was similar to the sharing tutorial in structure (see Figure 3. B), except that the parent was instructed to play the bucket game, and was given the home-practice instructions and activity log for the bucket game.

V2: Sharing Game

At V2, infants in both conditions participated in the sharing game, identical to the one in the sharing condition at V1.

Appendix B

Coding Scheme for Sharing, Releasing and Dropping Behavior

Share (for sharing game)

Infant intentionally releases the toy into E1's hand, upon E1's request.

Timing of release:

Letting go of the toy must be in response to request.

A request begins when E1 begins moving her hand (but not reaching out to take the toy from infant), and ends when E1 switches to another hand motion (when infant hasn't shared or dropped) or when infant drops or shares a toy.

Release can occur immediately after E1's hand movement begins, even before or at the same time of the verbal request.

Visual attention:

Must aim toy towards the upper surface of E1's hand.

Letting go of the toy must be preceded by visual attention to experimenter or experimenter's hand; accompanied by visual attention to toy, experimenter's hand, or experimenter; and followed by visual attention to toy, experimenter, or experimenter's hand.

Anticipatory looking toward the ground indicates the infant is expecting the toy to fall. In such cases, count as a drop, instead of a share, even if the toy ends up in E1's hand.

Expectation:

Infant is not surprised by experimenter taking the toy (cues: startled eye-blink, confused facial expressions).

Infant does not try to grab it back (this is different from reflex-movement of arms flailing).

Infant does not get angry/upset when experimenter takes the toy (cues: infant's brow furrows, gets fussy, etc.).

Special instances:

Allowances must be made for young babies' lack of coordination. In cases where the infant intends to share but the toy falls out of E1's hand, count as a share if it meets all other criteria.

- Do not count if toy fails to make contact with E1's hand at all.
- Do not count if toy is let go merely due to contact with E1's hand (e.g. infant pounds toy into hand and happens to let go due to the force of the pound).

If behavior is drop-like but meets other criteria and is above E1's hand, count as a share if the infant's hand is oriented down towards E1's. If it is pointed up or to the side, count as a drop.

Release (for Bucket Game)

infant intentionally releases the toy into the bucket upon E1's request.

Timing of release:

Letting go of the toy must be in response to request.

A request begins when E1 begins moving her hand (but not reaching out to take the toy from infant), and ends when E1 switches to another hand motion or when infant drops or bucket-releases a toy.

Release can occur immediately after E1's hand movement begins, even before or at the same time of the verbal request.

(*Appendices continue*)

Visual attention:

Must aim toy towards the center of the bucket.

Letting go of the toy must be preceded by visual attention to bucket or experimenter; accompanied by visual attention to toy, bucket, or experimenter; and followed by visual attention to toy, bucket, or experimenter.

Anticipatory looking toward the ground indicates the infant is expecting the toy to fall. In such cases, count as a drop instead of a bucket-release, even if the toy ends up in the bucket.

Note: the infant will often release toy in order to play with bucket, and this shouldn't count. Even if visual attention is there, do not count as a bucket-release if the infant's ultimate goal was to play with the bucket. Cue: if baby immediately grabs bucket after release.

Expectation:

Baby is not surprised by experimenter retracting the bucket (cues: startled eye-blink, confused facial expressions).

Baby does not try to grab the toy back (this is different from reflex-movement of arms flailing).

Baby does not get angry/upset when experimenter retracts the bucket (cues: baby's brow furrows, gets fussy, etc.).

Special instances:

Allowances must be made for young babies' lack of coordination. In cases where the infant intends to put toy in bucket but the toy falls, count as a bucket-release if it fulfills all other criteria.

- Do not count if toy fails to make contact with the bucket at all.
- Do not include clear instances where toy was let go merely due to contact with the bucket (e.g. infant pounds toy into bucket and happens to let go due to the force of the pound).

If the infant releases the toy into the bucket from some height above the bucket, count as a bucket release if the infant's hand is oriented down towards the bucket. If it is pointed up or to the side, count as a drop.

Drop (for Both Games)

the infant releases the toy in the request-response opportunity window and it is not a share/bucket-release. This can occur immediately after E1's hand movement begins, even before or at the same time of the verbal request.

Appendix C

Coding Scheme for Other Measures

Infant Visual Attention

For Infant trials, infants' visual attention was computed as the average proportion of the infant's looking time per request across all the trials in the sharing game. We coded the length of E1's requests and infants' looking time during each request. The length of E1's request varied according to infants' response. A request began when E1 started her hand motion; it ended when the toy was released into E1's hand or elsewhere, or when E1 switched to the next hand motion (when the toy was not released). The target area for coding infants' eye gaze included E1's face, E1's hand, or the toy (if infant's face, toy, and E1's hand formed a straight line, which means looking at the toy was in the same direction as looking at E1's hand). For Experimenter Trials, infant's visual attention was computed as the infant's average looking time across all the trials in the sharing game. We coded infants' looking time during each trial, and the length of each trial was fixed (around 33 seconds). A trial began when E1 held out the toy and addressed the infant, saying "Look/Watch/Look at this," and ended after E1 praised E2. Target area for infant's eye-gaze included E1's face, E2's face, E1's hand, E2's hand, and toy.

Positive Reinforcement

For E1's positivity score, 1 = *not at all positive* (E1 does not act in positive way at all), 2 = *a little positive* (E1 makes single comment, no raised pitch of voice), 3 = *somewhat positive* (E1 makes single or a few comments in relatively excited way, does not raise pitch of voice significantly), 4 = *very positive* (E1 makes single or a few comments in excited way, raises pitch of voice significantly in at least one comment), and 5 = *extremely positive*

(*Appendices continue*)

(E1 makes multiple comments all in highest pitch of voice). For infant's emotional reaction score, 1 = *not at all happy* (infant is noticeably unhappy, upset, frowning, etc.), 2 = *a little happy* (infant is relatively neutral or shows slight smile), 3 = *somewhat happy* (infant noticeably shows positive affect, or infant makes excited body movement without accompanying positive facial expression), 4 = *very happy* (infant shows positive affect accompanied by body movement), and 5 = *extremely happy* (infant shows positive affect accompanied by body movement and vocalization).

Parent Session Coding

for the first minute of the parent practice session at V1, we coded the following variables:

Available time: time when hand or bucket was extended out towards baby such that baby had an opportunity to share or bucket-release the toy.

Verbal requests: parent asks the baby to complete the action (e.g. "Can you put the toy in the bucket?", "Can I have it?", "Put it right there").

- If parent makes two requests in quick succession, still count as two separate requests (e.g. "Can I have it, can I have your toy?");
- Do not count when parent's sentence isn't a full request (e.g. "Right here." This is more of a specification than a standalone request.).

Physical cues: parent uses hand to encourage baby or direct baby's attention (e.g. pointing at the toy, waggling fingers, pointing into the bucket).

- If parent appears to be doing a motion continuously over a long period of time, count as only one cue. If parent pauses in the middle, making the movement discontinuous, count as multiple separate cues.

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